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This is to certify that

09 MAY 2003
REC'D 06 JUN 2003
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1) South African Patent Application No. **2002/0291** accompanied by a Provisional Specification was filed at the South African Patent Office on the **14 January 2002,** in the name of **DE BRUYN, Henri Arnold** in respect of an invention entitled: **"Aggregate stabilizer."**

2) The photocopy attached hereto is a true copy of the provisional specification and drawing filed with South African Patent Application No. **2002/0291.**

Geteken te PRETORIA In die Republiek van Suid-Afrika hierdie 30th dag van April 2003
Signed at PRETORIA in the Republic of South Africa this 30th day of April 2003

Registrateur van Patente
Registrar of Patents

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G.P.-S. 019-0194

FORM P 2
(To be lodged in duplicate)

REPUBLIC OF SOUTH AFRICA — PATENTS ACT, 1978

REGISTER OF PATENTS

Official application No.	Lodging date: Provisional	Acceptance date
21 ZA 2002/0294	22 14 JAN 2002	47
International classification	Lodging date: Complete	Granted date
51 ~~[illegible]~~	23	

Full name(s) of applicant(s)/Patentee(s):

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Applicants substituted:	Date registered
71 —	

Assignee(s):	Date registered
71 —	

Full name(s) of inventor(s):

72 HENRI ARNOLD DE BRUYN

Priority claimed	Country	Number	Date
	33	31	32
	33	31	32
	33	31	32

Title of invention

54 AGGREGATE STABILIZER.

Address of applicant(s)/Patentee(s): 31 JACK BENNET ST STERREWAG PRETORIA

Address for service: D.M. KISCH. INC,

74 31 ~~JACK BENNET ST STERREWAG PRETORIA 0184~~

Patent of addition No.	Date of any change
61	

Fresh application based on	Date of any change

P 015 (E)

G.P.-S. 019-0128

REPUBLIC OF SOUTH AFRICA

PO 32 E
Form P 1

PATENTS ACT, 1978

APPLICATION FOR A PATENT AND ACKNOWLEDGEMENT

[Section 30 (1)—Regulation 22]

(See notes overleaf)

REGISTRAR OF PATENTS, DESIGNS TRADE MARKS AND COPYRIGHT
R50 R10
2002 -01- 14
REGISTRATEUR VAN PATENTE, MODELLE, HANDELSMERKE EN OUTEURSREG

The grant of a patent is hereby requested by the undermentioned applicant on the basis of the present application filed in duplicate.

Official Application No.		
21	01	2002/0291

(i)

Applicant's or agent's reference

(ii)

71	Full name(s) of applicant(s)	HENRI ARNOLD DE BRUYN

(iii)

	Address(es) of applicant(s)	31 JACK BENNET ST STERREWAG . PRETORIA

(iv)

54	Title of invention	AGGREGATE STABILIZER

(v)

	The applicant claims priority as set out on the accompanying form P 2.

(vi)

	This application is for a patent of addition to Patient Application No.	
21	01	

(vii)

	This application is a fresh application in terms of section 37 and based on Application No.	
21	01	~~YES~~

(viii)

	This application is accompanied by:	
✓	1.	A single copy of a provisional ~~or two copies of a complete~~ specification of 5 pages.
	2.	Drawings of 0 sheets.
	3.	Publication particulars and abstract (form P 8 in duplicate).
	4.	A copy of Figure 0 of drawings (if any) for the abstract.
	5.	An assignment of invention.
	6.	Certified priority document(s) (state number).
	7.	Translation of the priority document(s).
	8.	An assignment of priority rights.
	9.	A copy of the form P 2 and the specification of S.A. Patent Application No. 21 01
	10.	A declaration and Power of Attorney on form P 3.
	11.	Request for ante-dating on form P 4.
	12.	Request for classification on form P 9.
	13.	

(ix)

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Dated this 14 day of JAN 2002

Signature of applicant(s) or agent

REGISTRAR OF PATENTS, DESIGNS, TRADE MARKS AND COPYRIGHT
Received
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2002 -01- 14

Form P6

REPUBLIC OF SOUTH AFRICA

PATENTS ACT, 1978

PROVISIONAL SPECIFICATION

(Section 30(1) - Regulation 27)

Official Application No.		
21	01	2002/0291

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Full name(s) of applicant(s)
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Title of invention
54 AGGREGATE STABILIZER.

(RP42E)

2002/0291

AGGREGATE STABILIZER

This invention relates to a chemical compound, its use and method to strengthen soil and other aggregates and to render it more water resistant.

The chemical compound consists of urea formaldehyde precondensate made to react in two phases, first alkaline, then acidic before, during and/or after being mixed with water and the aggregate. Such alkalinity could range from more than 7 pH to 11 pH initially, which is then reduced to between 2,5 and 5,5 pH acidity.

This invention further relates to such chemicals being mixed in a certain ratio, whereby there is an excess of formaldehyde to the urea so as to allow further cross linking to take place over an extended time period in the matrix formed by the compound and the aggregate. Such excess molar ratio could be 2:1 formaldehyde to urea or vary from 1,2 to 2,5 to 1.

This invention further relates to a weak organic acid being used as catalyst, so as to extend the reaction time over a longer period, rather than shorter reaction times being achieved by stronger inorganic acids. Such weaker organic acids may be citric or acetic acid or a combination of these or other organic acids such as humic acids which may be added or formed as below.

This invention further relates to sugar or other organic materials being mixed in with this catalyst and / or the compound so as to allow further humic acids or other organic compounds to form. These humic acids and organics have been found to enhance the strength and water resistance of the matrix considerably due to longer polymer chains, enhanced cross-linking and increased molecular weights of the polymers. It has further been found that this substantially enhances the adhesion and cohesion of the polymers to the aggregate due to better adsorption of the chemicals on the interface or surface of the particles of the aggregate, largely due to the electrical forces, polarities and other chemical properties resulting at these interfaces.

The formaldehyde is increased in relation to the urea to allow for the reaction with the organics, humic acids or catalyst. UFC (Urea Formaldehyde precondensate) with reduced free formaldehyde is preferred to reduce emissions.

This invention further relates to bitumen emulsion being used in the compound and matrix. Anionic Bitumen Emulsion is preferred as its alkaline properties allow the use of more catalyst and humic acids described above, which improve the quality of the polymer, binder and matrix.

Similarly latex or other alkaline substances such as Portland or other cement could be used to achieve a better matrix, binder and general results and strengths.

It has further been discovered that this binder and matrix is considerably strengthened by adding silanes to the compound. That binds the organic polymer chains on the one side to the silicons and oxygen or other elements present in aggregates on the other side. This considerably increases the strength and water resistance of the compound as well due to the substantially increased chemical bonds between the polymer and the aggregate, especially together with the

increased adsorption onto the interfaces by the chemicals and the organics described above.

Water resistance of the matrix is further enhanced by adding poly vinyl alcohol to the compound of adequate molecular weight e.g. degree of polymerization between 500 and 2200.

Enhanced properties can further be obtained by using a buffer or adding UV blocking agents, silicones or silanes, biocides, oxides, plasticizers or ammonium salts.

In a preferred embodiment the aggregate consists of soil, sand, silt, clay or gravel and stones or rocks, preferably well graded with ample fines between the larger particles

This invention further relates to initially water soluble chemicals that permeates even fine soils while dissolved in the water, which then react to form a water insoluble binder in the matrix. Most other binders are solids, which do not permeate well or at all into other solids e.g. the aggregate and remains on the surface thereof. This invention permeates into other solids while water soluble, then reacts in that location and sets into a water insoluble solid, which does not then leach out. Many other binders remain water insoluble and later leach out, resulting in substantial loss of strength of the matrix. This aspect allows the binder to permeate into small clods, which solid binders cannot do, thus resulting in excellent and consistent strength – also in underground grouting.

This invention, used in the correct ratios and method substantially reduces emission of formaldehyde fumes during application. Factors that contribute to this major benefit are the weak organic catalyst, bitumen emulsion, water, the aggregate itself, the organics and the relatively slow reaction time, which keep reaction temperatures lower which reduce emission. Other uses of Urea Formaldehyde resins usually occur faster and at higher temperatures with possibly higher emission rates, often resulting in a gel rather than the hard solid attained from this invention.

This invention further relates specifically to the method of application to obtain a sound matrix with effective strength and results.

This relates to mixing the chemical components with adequate water first and then mixing it or penetrating it into the aggregate. This ensures excellent spread and dispersal of chemicals into the aggregate and reduces emissions, as formaldehyde gas is hygroscopic.

A preferred method of mixing is to first dissolve the urea in water, then add the bitumen emulsion, then the Urea Formaldehyde Concentrate, then the catalyst and then the other additives, except latex, which can be dissolved in water and mixed in separately to prevent it from breaking from the its emulsion. Other sequences of mixing can also be used.

This emulsion further relates to a method of mixing the chemicals with water and then spraying this onto the surface of the aggregate. It has been discovered that the water soluble components penetrate into the aggregate to harden and water proof the inside of the aggregate while the solids such as bitumen or latex remain in or near the surface of the aggregate to form a stronger and more impermeable skin in this area. This results in an effective lining very useful e.g. as in dam or pond linings

or to waterproof bricks, roads etc and further reduces emissions of gasses as it helps to keep the formaldehyde gas in the matrix after the water evaporated, until it reacts with the urea.

In a preferred embodiment the water dissolved or suspended chemicals are mixed into the aggregate physically with a spade, grader, rake, plough, etc. and then compacted. Compaction plays a vital role as this allows the polymer chains to form in close proximity to the surface of the aggregate particles. Compaction is further important as it greatly enhances the strength of the matrix.

A further important aspect of this invention is to form a soil aggregate matrix at optimum moisture content so as to obtain best compaction. Too dry or too wet soil or aggregate does not compact well and therefore the compound is mixed with the correct amount of water to achieve this result. This achieves an excellent spread of chemicals throughout the matrix, even into small clods.

An intrinsic aspect of this invention is the combination of the above and other factors in the correct ratios, quantities or ways so as to achieve optimum matrix results. It has often been found in tests that each of these components or combinations thereof are vital to construct an effective matrix in many cases.

EXAMPLE:

1. Take 1 kg (1000 g) of soil, preferably evenly graded with small to larger particles.
2. Establish the moisture content whereby this soil compacts optimally e.g. 5% (5 percent) water added (weight / weight). Put this 50 grams of water in a mixing vessel.
3. Add 7 grams of urea granules to the water and stir for 15 minutes or until dissolved.
4. Add 15 grams of bitumen emulsion (anionic)
5. Add 22 grams of UFC
6. Add 1 gram of citric acid previously treated with sugars – dissolved into it (say 30% concentrate)
7. Add 1 gram humic acids (reduce or increase acids if pH is less than 3 or more than 5)
8. Add the other additives as required e.g. silanes 0,2% of the weight of the resin above i.e. 1 gram
9. Mix thoroughly with the soil.
10. Mix 2 grams of latex with 8 grams of water and mix this well into the aggregate.
11. Mix 5 grams of the chemicals in 3 to 8 above with 5 grams of water and spray onto aggregate etc.
12. Compact well
13. Let dry at ambient temperature – Do not cure with further water as for cement.

EXAMPLE 2

1. Follow steps 1 to 8 above.
2. Spray the liquid onto the surface of the soil
3. Spray the liquid of steps 10 above onto the soil (only permeate or mix in).
4. Let dry until closer to optimum moisture content.

5. compact (less compaction than in example 1)
6. Let dry - Do not cure with water.

It is an important aspect of this invention that the chemical reaction takes, place at ambient temperatures. This matrix thus formed makes it possible to use abundant materials e.g. a wide range of soils to construct roads, make bricks, floors, stabilize embankments, form pond linings etc. at low cost without having to bake such aggregates to harden it into a matrix.

A further aspect is that this can be done, in a user and eco friendly and economical way with conventional equipment, thus creating an effective new building material.

Layers of different matrixes can be constructed to obtain different strengths at different costs or different water levels of water impermeability – simply add more or less chemicals to different layers and a workable road surface or water impermeable brick is obtained at low cost. (Rather than make the whole matrix strong to get a stronger surface).

This invention further relates to a product or artifact made from the above materials and/or per the methods described above and the use thereof.

An effective matrix can be obtained by optimally combining the following major (and other minor factors), constructed by using the method described above.:

1. Using the best soil or aggregate available economically at a particular location, or importing and mixing other soil or aggregates into this aggregate to obtain a more continuous grading of particles or other properties desired or available.
2. Batching and mixing the chemicals in optimal ratios.
3. Mixing these chemicals with the correct amount of water to obtain optimum or effective compaction and or permeation of the aggregate.
4. Mixing the aggregate, chemicals and water together or allowing the permeation of the liquids, solids and gases into an effective mix in the aggregate.
5. Causing the desired form of the matrix by shaping or permeating the aggregate and matrix into this form.
6. Compacting the matrix in this form or allowing the mixed in or permeated chemicals to set in this form.

AGGREGATE STABILIZER

ABSTRACT: This aggregate stabilizer relates to a chemical compound to strengthen soil and other particles to render it more water-resistant and impart certain other properties to the matrix so formed. It further relates to the use and method of application of stabilizer and matrix.